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Estimating the Economic Benefits of a Wetland Restoration Program in New Zealand: A Contingent Valuation Approach

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Abstract

Decades of failure to evaluate the ecosystem services provided by Pekapeka Swamp in New Zealand led to decisions that allowed prolonged degradation of the swamp, resulting in the loss of potential economic value. In 1998 a long term management plan was adopted to restore and preserve the swamp without evaluating the potential welfare benefits of the plan. This study contributes to literature by providing the first estimation of total economic value (TEV) of the restoration and preservation of Pekapeka Swamp. Using the contingent valuation method, this study shows that estimated TEV ranges from NZ$1.64 million to NZ$ 3.78 million per year and the net present value ranges between NZ$5.05 million and NZ$16.39 million. These results imply that the restoration and preservation of Pekapeka Swamp is an important investment.

Keywords: contingent valuation method; wetland; dichotomous choice; willingness to pay; New Zealand

1. Introduction

The primary purpose of ecosystem and ecosystem services (ES) valuation studies is to recognize the fragility and increasing scarcity of the services freely provided by nature that we all benefit from and are reliant on for our well-being. The market paradigm that we operate in places value on the direct contributions that ecosystems provide, such as agricultural produce and timber, but does not put value on the significant non-market goods and services provided such as climate regulation, water filtration, and habitat (Costanza et al., 1997; Daily, 1997).

Ecosystem services valuation studies expand information boundaries and provide a means of communicating the importance of ecosystem functions. Additional knowledge allows decision-makers to better identify, prioritise and protect critical ecosystems/ecological resources under pressure as well as promote remediation and restoration actions. Valuation studies can therefore provide policy makers with the necessary economic and non-economic information for the development of efficient and effective strategies for ecosystem management.

Some argue that ecosystems and their services cannot or should not be valued in monetary terms (Sagoff, 1988; Heal, 2000; Spash et al., 2005). Reasons cited are that valuation is an anthropocentric approach that disregards other species; it is a pointless exercise as ecosystems are non-substitutable and their value approximates infinity as humans cannot exist without them; moral values cannot be reduced to the monetary calculation of cost-benefit analysis; the complexity of ecosystem services makes any scientific estimates of their contribution highly uncertain; and, placing a monetary value on non-substitutable goods gives the impression that man-made goods can actually replace the services. However, it can also be argued that every decision involves value judgment, and providing an estimate of the value of the contribution made by ecosystems allows this to be done with more rationality than assigning a zero value which is often implied when no value is given. In addition, the usual objective of ecosystem services valuation studies is not to establish a market place exchange value but to ensure that specific non-market services provided by ecosystems are adequately incorporated into the decision-making process. In any choice of one alternative over the other we are expressing a preference and “we cannot avoid the valuation issue because as long as we are forced to make choices, we are doing valuation” (Costanza and Folke, 1997, p. 50). It can also increasingly be argued that ignoring the explicit valuation and inclusion in decision making of ecosystems and their services is not an option in the face of rapid global environmental changes, ecosystem degradation and loss. A lack of information on the full economic costs and benefits of alternative uses of ecosystems has consistently led to policy decisions that permit the destruction of forests and wetlands, and the pollution of rivers, lakes, and coastal areas.

The study applies the Contingent Valuation Methodology (CVM) which is a non-market valuation technique that has been developed to estimate the monetary values of non-market goods and services for use in environmental damage assessments and cost-benefit analysis (CBA) of public policy or projects. Non-market valuation literature provides many examples of studies that employed the CVM to estimate TEV of wetlands (see for example: Bateman et al., 2000; Loomis et al., 2000; Oglethorpe and Miliadou, 2000; Wattage, 2002; Zhongmin et al., 2003; Wattage and Mardle, 2007 and Ghosh and Mondal, 2013).

However, this paper is significantly different from its predecessors in several aspects. First, it contributes a New Zealand ecosystem services valuation to the international valuation literature for wetlands. It also provides New Zealand with a current country-specific value for wetlands which has been lacking. Prior to this study the only available estimate was a valuation of the Whangamarino wetland completed in 1988 (Kirkland, 1988). Despite the fact that New Zealand experienced large scale losses of wetlands over the past 160 years, little effort has been made to evaluate the impact of such losses on well-fare. Of the original wetland area of 2.47 million hectares just 10% now remains (Ausseil et al., 2008). Early settlers drained wetland systems and converted them to urban settlements[1], pasture and cropland. As wetlands in New Zealand remain under threat from human activities, their preservation, protection, and restoration is a priority. For this reason, this wetland valuation study was undertaken to firstly estimate the total economic value (TEV) of benefits that could potentially be delivered by a public policy programme for the restoration and preservation of the Pekapeka Swamp in the Hawke's Bay region of New Zealand; and secondly to test the economic efficiency of the policy programme by comparing the costs and benefits.

This study also contributes to existing knowledge in a number of ways. Firstly, a New Zealand specific valuation provides more information for policy makers when considering policy options for wetlands. Secondly, it increases the breath of ecosystem and ecosystem services valuation literature available internationally. As empirical valuation methods are time consuming and expensive to complete there is greater use being made of benefit transfer and meta-analysis which are both reliant on having multiple on-the-ground studies to use. Benefits transfer is an economic valuation tool that uses existing non-market valuation studies and applies values from them to the policy site (Bateman *et al*., 2000; Bateman *et al*., 2002; Champ, Boyle, & Brown, 2004; Freeman III, 2003). For example, the Pekapeka swamp estimates could be used to value a similar wetland in New Zealand by directly applying the unit value (either adjusted or unadjusted) or by transferring a value function (WTP function). Meta-analysis involves collecting data from many sources (of which the Pekapeka swamp estimates could be one) and extrapolating and applying consistent patterns and relationships

[1] A number of the major cities in New Zealand, including Christchurch in the South Island, and Hastings in the North Island were built on swampland after extensive drainage of the surrounding areas.

about ecosystems values and the services they produce to a new policy site. Thirdly, as the study sets out in detail the methodology and the value functions constructed, this overcomes one of the common criticisms of valuation studies that they do not provide sufficient information on the econometric analysis undertaken (Brouwer, 2000).

The following section describes the case study site, and Section 3 describes and discusses the methodology used. Section 4 presents and discusses the results, and Section 5 provides a general conclusion.

2 Description of Pekapeka Swamp

Pekapeka Swamp (see Figure 1), located 12 km south-west of Hastings, is a site of national and regional interest in New Zealand because of its ecosystem and unique Maori cultural and social significance (Hawke's Bay Regional Council (HBRC), 1999). The swamp is 4.5 km long, 0.8 km wide at its widest point, covers 91.55ha and provides a natural flood soak during heavy rain. The swamp has become degraded over an extended period of time as a result of commercial over-fishing, agricultural run-off from surrounding farmlands, livestock grazing, drainage, dumping of waste materials, and invasion and over-growth of weeds (HBRC, 1999, 2005). Biodiversity is endangered with native fish, plant and bird species numbers all reduced dramatically. The site currently offers limited recreational opportunities with duck shooting the only significant local recreational activity (HBRC, 2005).

The swamp usually suffers water shortages during summer/autumn months due to evaporation and low rainfall (HBRC, 1999). The two dominant vegetation categories are raupo and willow. Raupo is native and grows naturally in swampy areas. Two of the willow species, crack willow (*Salix fragilis*), and pussy willow (*Salix atrocinerea*) were introduced into New Zealand and are invasive pests therefore targeted for eradication from the swamp. The weeping willow (*Salix babylonica*) provides habitat for wildlife and does not spread or pose a threat to the swamp. There are also small areas of sedges, rushes and grassland.

The swamp provides habitat to a variety of resident and migratory (native and exotic) bird species, some of which are extremely rare. By providing a passage for fish up the Poukawa stream to Lake Poukawa, Pekapeka Swamp is an important part of the Poukawa fishery. The long finned eel (*Anguilla dieffenbachii*), short finned eel (*Anguilla australis*) and inanga (*Galaxias maculatus*) used to be the dominant fish species before the swamp was degraded and over-fished (HBRC, 1999). These species are under threat throughout New Zealand.

In 1968, half the area of the swamp was purchased under the Public Works Act primarily for soil conservation and river control purposes (HBRC, 1999). Since then acquisition of land near the swamp has seen the gradual transfer of ownership from the private sector to the HBRC. Most purchases occurred in 1998 with the last purchase of 1.45ha in June 2004 (HBRC, 1999, 2005).

A public programme managed by HBRC is under way to restore and preserve the environmental balance of the swamp through fencing out livestock, chemical and physical eradication of the invasive willows, replanting of native plant species, construction of a weir to ensure adequate water levels all year round without restricting the movement of fish up and down the stream, and management of activities to permit the system to regenerate itself with minimal negative impacts from the surrounding farming activities and public access (HBRC, 1999, 2005). The HBRC argue that a restored and protected Pekapeka Swamp would support increased plant, fish and bird species; and offer, to the local and regional community, increased recreational opportunities such as waterfowl hunting, fishing, camping, picnicking and walking.

3 Methodology

3.1 Contingent Valuation Method (CVM)

The CVM is the most widely used technique for estimating economic values of non-market goods and services (Carson, 2000; Ndebele, 2009) as it allows for the incorporation of non-use or passive values (Bateman and Langford, 1997). The majority of CV applications have been undertaken for the purpose of assisting in policy evaluations (Carson, 2000). The Contingent Valuation (CV) technique is an approach based on the direct elicitation of value from individual respondents through the use of carefully designed and administered sample surveys (Mitchell and Carson, 1989; Hanemann and Loomis, 1991; Arrow et al., 1993; Venkatachalam, 2004). Contingent valuation surveys are "designed to create the missing market for public goods by determining what people would be willing to pay (WTP) for specified changes in the quantity or quality of such goods or ... what they would be willing to accept (WTA) in compensation for well-specified degradations in the provision of these goods" (Carson et al., 2003, p. 258).

Non-market valuation literature recognizes that only stated preference (SP) methods are capable of capturing non-use or passive use values (Mitchell and Carson, 1989; Loomis et al., 2000; Carson et al., 2001; Bateman et al., 2002). Bateman et al. (2002, p. 74) recommends the use of SP methods where non-use values are likely to be important and identifies the CVM as the most appropriate method to apply "when the WTP for the environmental good or service in total is needed." Since our objective is to estimate the total economic value (inclusive of passive use value) of the benefits that could be delivered by a fully functional wetland, CVM becomes the method of choice.

3.1.1 Contingent valuation survey design: development and structure

The CV survey instrument used in the study was developed based on the results of a contingent valuation (open ended format) pilot study conducted in October 2008 involving a random sample of 159 households in the Hawke's Bay region; comments from the Hawke's

Bay Regional Council (HBRC); and feedback from a focus group (see Ndebele, 2009). The design of the survey instrument followed, as far as possible, the Total Design Method (TDM) of Dillman (1978) and incorporated recommendations of influential literature such as Heberlein and Baumgartner (1978); Boyle and Bishop (1988); Mitchell and Carson (1989); Arrow et al. (1993), and Bateman et al. (2002).

The CV survey instrument consisted of a cover letter, a survey questionnaire booklet, and two reminders. The survey was designed to be administered through the mail to a regional sample of households randomly drawn from the Hawke's Bay telephone directory. Hawke's Bay is a district in the north island of New Zealand. Although some benefits from the restored wetland could potentially extend beyond local, regional and national boundaries, our target population for both pre-test and main survey was restricted to the Hawke's Bay region since the public policy programme being evaluated is funded from local sources. Aggregating the TEV of the swamp over the population of Hawke's Bay excludes the potential benefits for people residing outside the region and therefore provides a lower bound for the value of the swamp. However, restricting the target population to a particular jurisdiction may result in higher average WTP values as the effects of distance decay are minimized.

Part 1 of the survey questionnaire provided the introduction and background information including a social utility argument; a definition of a wetland; provided a list of valuable services that wetlands perform such as flood control, habitat for animals and fauna, water purification, recreation, and climate control; and a map showing the location of the study site. The second part of the survey questionnaire was designed to collect information on respondents' awareness of the existence of Pekapeka Swamp, and respondents' participation in wetland-based recreational activities. Part 3 built on the previous section and provided a list of reasons for valuing existing wetlands such as, protecting wildlife and wildlife habitat;

providing scenic beauty, commercial income, recreational opportunities, flood control, and water purification; and non-use value considerations such as option, existence and bequest values. Respondents were asked to indicate, by a tick, the importance of each reason on a five-point scale from "No Opinion" (0) to "Extremely Important" (4). Respondents' attitude towards environmental protection was tested by presenting them with conflicting land uses for the site – "agricultural development versus preservation of ecosystem services", and asking them if they would support an environmental programme that seeks to restore and preserve the site at no direct cost to themselves. The hypothetical or contingent scenario for the valuation of the restoration and preservation of Pekapeka Swamp was then outlined.

3.1.2 Contingent scenario

The contingent scenario consisted of three scenarios presented with the aid of colourful pictures and a brief description of the scenarios. The 'Status quo scenario' showed how the wetland currently looked and was based on photos taken at the site; 'Future scenario 1' depicted how the site would look if the restoration and preservation programme was not opted for and the site converted to agricultural use[2]; and 'Future scenario 2' showed how the site could potentially look if the restoration programme progressed. Before the valuation question was posed, respondents' potential use of the restored Pekapeka Swamp was explored. This gave respondents an opportunity to consider and reflect on the potential benefits that they could derive from the restored wetland without the burden of placing a value on these benefits. By the time the valuation question was posed, it was expected that the individual had

[2] If the restoration and management programme for the study site is abandoned it is assumed that agricultural development would take precedence over other potential competing uses for the land surrounding the wetland because of its location in a farming zone. Land previously bought from the surrounding farmers would be sold back to the original owners who would use it for agricultural purposes and the counterfactual without the restoration is depicted to reflect this.

enough information and considerable forethought on the value of the benefits of the programme.

3.1.3 Valuation question and payment vehicle

The valuation question consisting of a dichotomous choice question with an open ended follow-up[3] was posed within the contingent scenario. Each respondent was presented with one of the 16 bid amounts representing the annual amount to be paid for the next five years. Respondents were reminded before answering the valuation question: to consider their income and other financial commitments (budget constraints); of the benefits they could derive from the restored site (total value); that alternative sites may exist (substitution); and to discuss their answers amongst the household members (consensus). It was important to remind respondents in this manner to ensure that realistic valuations that conform to the utility theory were stated. Results of a pre-test CV survey of 158 households in the Hawke's Bay region were used to empirically define a bid range of NZ$1 to NZ$200 for the main survey. The 16 bid levels used in this study are; $1, $10, $20, $30, $40, $50, $60, $70, $80, $90, $100, $120, $140, $160, $180, and $200. The payment vehicle was a special levy collected via regular utility bills over a period of five years. To mitigate free-rider effects, respondents were asked to assume that the restoration and preservation programme would only proceed if all households paid the proposed levy (Oglethorpe and Miliadou, 2000). The valuation question posed was:

> "Now assume that the only way to restore and preserve the Pekapeka Swamp is for all households to pay into the special fund, mentioned on page 5, to be used exclusively for this purpose. Now suppose that this program would cost your household $[**seed**] each year for the next five years. Keeping in mind your household income and other

[3] Examples of studies adopting a similar valuation framework include: Seller, Stoll and Chavas (1985), Smith et al. (1986), Boyle and Bishop (1988), Stevens et al. (1991), O'Connor et al. (1999) and Amirnejad et al. (2006)

financial commitments, and that similar wetlands will continue to exist elsewhere in New Zealand, would your household vote in favour of this program? (Please tick one answer only and write the amount in the space provided.)"

Four possible answers to the valuation question were provided as indicated below and respondents were asked to select one option.

1. [ ] YES. In fact my household would vote to support this programme even if it cost us up to $.................. per year. (Please write in the space provided the maximum amount your household would pay).
2. [ ] NO. We would not vote in favour of this programme because the amount is too much. We would, however, vote to support this programme if it cost my household $.................. per year. (Please write in the maximum amount that your household would pay).
3. [ ] NO. We would not vote in favour of this programme because (Please tick one):
    - a. [ ] Wetlands are not worth anything to us.
    - b. [ ] We refuse to place a dollar value on wetlands.
    - c. [ ] We do not approve of the levy.
    - d. [ ] We cannot afford to pay anything.
    - e. [ ] Other (Please specify): ....
4. [ ] We have no opinion because (please tick one):
    - a. [ ] WE don't really care about wetlands.
    - b. [ ] WE can't make a decision without more information.
    - c. [ ] Our opinion won't make any difference.
    - d. [ ] Other (please specify): ....

The first option provided for a “YES” answer to the DC question and a provision for the respondent to state a maximum annual amount at which they would still support the programme. If the respondent selected this option, the open ended WTP amount was expected to be at least equal to the bid offer. A lesser amount would indicate inconsistent valuation or a selection error (i.e. placing a tick in the wrong box) or a misunderstanding of the valuation question. The second option provided for a “NO” answer to the bid offer and a provision to state the highest possible amount, below the bid offered, at which the respondent would support the programme. The third option provided for zero valuation and was structured to identify genuine zeros from protests. The fourth option allowed respondents to express “NO OPINION” and select possible reasons for this answer from a suggested list or to specify some other reason in the space provided.

3.1.4 Respondent’s profile

The last part of the survey questionnaire was designed to collect respondents’ personal profiles. Information on socio-economic characteristics such as age, education, gender, occupation, household income, family size, and ethnicity was collected (Zhongmin et al, 2003; Amirnejad et al, 2006; Lienhoop and MacMillan, 2007).

3.1.5 Survey execution

The Pekapeka Swamp contingent valuation survey was administered to a sample of 958 households in the Hawke’s Bay region, from November 2008 through to January 2009. The cover letters were personalized and individually signed. The first mail out consisted of a cover letter, survey questionnaire and an addressed postage-paid return envelope. Two reminders were mailed out at approximately three week intervals. The first follow-up was a reminder/thank-you postcard to all non-respondents encouraging them to respond. The second reminder consisted of a replacement questionnaire with a more emphatic cover letter and an addressed postage-paid return envelope.

3.2 Model specification for estimating willingness to pay

Two models were used to analyze and estimate WTP functions and WTP values from responses to the survey questionnaire. Responses to the DC question were analyzed using logistic regression while responses to the OE question were analyzed using ordinary least squares (OLS) regression. In both models we hypothesize that socioeconomic and demographic variables are important explanatory variables. We have no theoretical basis to pre-select the variables that provide the best model. To address this problem, forward stepwise regression was employed to select among the possible variables.

3.2.1 The logit model

The logit model applied to our dataset is based on a WTP framework along the lines developed by Hanemann (1984) from which the household Hicksian compensating surplus is estimated (Bowker and Stoll, 1988). The respondent is presented with a given improvement in environmental quality at a stated price (bid amount) and then asked to cast a vote in favour of or against the programme. The respondent takes the environmental quality as given but is free to decide on the value or the price to pay. Following Pate and Loomis (1997), Lee and Han (2002), Amirnejad et al. (2006), and Ndebele (2009), the logistic regression model developed to analyze the data is as follows:

$$log\left\{\frac{Prob(yes)}{(1-Prob(yes))}\right\} = \alpha - \beta A + \gamma Y + \theta Z \qquad (1)$$

where A, Y, and Z are bid amount (or Seed), household income, and a vector of socio-economic variables hypothesized to influence household WTP respectively; α is a constant; β

and γ are the coefficients on bid amount (Seed) A and income Y respectively; and θ is a vector of coefficients on Z; Prob(yes) is the probability that the household will accept the bid offer (A) and is given by the formula:

$$Prob(yes) = \{1 + \exp[-(\alpha - \beta A + \gamma Y + \theta Z)]\}^{-1} \qquad (2)$$

and (α - βA + γY + θZ) is a linear equation for the utility difference (ΔV).

Estimating the logit model (equation 1) provides estimates of parameters in equation (2). The expected value of WTP (truncated mean) can be calculated from equation (2) by numerical integration ranging from zero to maximum bid ($A) using the following formula (Hanemann, 1984; Lee and Han, 2002; Haab and McConnell, 2003; Amirnejad et al., 2006):

$$\begin{aligned} E(WTP) &= \int_0^{Max.A} F_\eta(\Delta V)dA) \\ &= \int_0^{Max.A} \left(\frac{1}{1 + exp\{ -(\alpha^* + \beta A)\}} \right) dA \end{aligned} \qquad (3)$$

where $\alpha^* = \alpha + \gamma\overline{Y} + \theta\overline{Z};\ \ \beta < 0;$

and $F_\eta(.)$ is the cumulative distribution function (cdf) of a standard logistic variate.

Hanemann (1984, 1989), Cameron (1988), Pate and Loomis (1997), Haab and McConnell (2003) suggest another formula for estimating the unrestricted mean[4] (or median) from the fitted model using a formula of the form:

$$E(WTP) = (\frac{\alpha}{\beta}) + \sum_{i=1}^{k-1} \frac{\theta_i}{\beta} \overline{Z}_i \qquad (4)$$

where k is the number of explanatory variables in the fitted logit model.

Equation (4) involves transforming all the coefficients in the estimated model [except the coefficient on the bid (Seed) amount] by dividing them by the absolute value of the coefficient on Seed, multiplying each transformed coefficient by the mean of the

[4] We will refer to the unrestricted mean as mean.

corresponding variable, and then summing them up. By dividing all the coefficients in the estimated logit equation by the absolute value of the coefficient on Seed, we transform them "into coefficients with ordinary least squares interpretation, insofar as the estimation of the impact on WTP" (Pate and Loomis, 1997, p. 203).

3.2.2 Open-ended WTP model

Open ended valuation questions produce a set of welfare measures WTP_i (i = 1,……n) for *n* respondents in the sample. The mean WTP can be estimated as:

$$Mean\ \ WTP = \frac{\sum_{i=1}^{n} WTP_i}{\text{n}} \tag{5}$$

An estimate of total value is obtained by multiplying the mean WTP by the population size or number of households. Alternatively the total value may be estimated from the estimated WTP function (bid function) by using the population data on the estimated equation. The open-ended WTP model is specified as per Seller, Stoll and Chavas (1985) as:

$$WTP = f(Y, Z) \tag{6}$$

where WTP is the Hicksian compensating measure of WTP; Y, and Z are as defined in section 3.2.1.

4 Results

4.1 Descriptive statistics

Out of the original sample of 958 households, 80 (8.35%) questionnaires were returned undelivered for various reasons.[5] A total of 177 (18.48%) responses were obtained before the deadline from the initial mail out. The first reminder resulted in a further 63 (6.58%)

[5] Mail was returned for reasons such as, box closed, deceased, not known, no such number, insufficient address, not at this address, and no delivery point.

responses whilst the second reminder resulted in 165 (17.22%) responses giving a total response rate of 42.28%. A total of 473 (49.37%) respondents did not return the questionnaire. When undelivered mail is deducted from the original sample size and the response rate calculated as a percentage of the mail assumed to have reached the respondents, a slightly higher response rate of 46.13% is obtained.

Table 1 represents response categories to the contingent valuation question. Respondents who selected response option 3a or 3d to the valuation question or option 2 and indicated a zero WTP response to the open-ended valuation question were assumed to express genuine zeros. Selections of option 3b or 3c were classified as protests whereas the selection of option 3e was classified as either protest or genuine zero depending on what was stated. Responses by e-mail, letter and telephone stating that the respondents did not wish to participate in the survey and the return of the survey questionnaire uncompleted were classified as refusals. Selections of option 4 were classified under "No opinion". Incomplete valuations included responses where respondents answered most parts of the questionnaire but did not answer the valuation question. Non-zero responses include all responses that state WTP values greater than zero.

Responses classified under protest zeroes, refusals, "No opinion", and incomplete valuations were excluded from the final sample used to estimate WTP. Also exclude from the final usable sample of 231 were inconsistent valuations and those that only answered the DC question but not the OE question and vice versa[6]. Respondents who accepted (rejected) the bid offer accounted for 38.13% (61.87%) of those who answered the valuation question excluding protests and "No opinion". As expected the proportion of "yes" responses to the DC question declined whilst the proportion of "no" responses increased as the bid amount increased. Only 4 (0.99%) respondents gave responses to the open ended question without

[6] These were omitted so that the same numbers of observations were used in both the logit and OLS models to allow for comparison of the results based on responses from the same respondents.

answering the DC question compared to 1 respondent who answered the DC question but did not respond to the OE question. Of those respondents who gave inconsistent answers to the valuation question, 38 answered "yes" to the DC question but stated lower OE WTP amounts and 1 answered "no" to the DC question but stated an OE WTP amount equal to the bid offered.

An analysis of early and late responses revealed that late respondents did not report values statically different at the 5% level from those reported by early respondents except for Activity2 (see Table 2 for a full description of variables). [7] We may therefore conclude, with qualification, that our response rate of 46.13% is adequate and that it may represent the population as well as would a higher response rate because early and late respondents did not report values that are statically different (Walsh et al., 1984; Sutherland and Walsh, 1985) at the 5% level. Our results generally support the findings by Wellman et al., (1980) that there is no significant difference between early and late respondents. However a better way to demonstrate that sample responses are representative of the population is by examining the attitudes of non-respondents which is often very difficult[8], or by comparing the sample statistics with that of the general population.

To investigate how closely our sample represents the population, we compared the sample statistics to the population statistics provided by Statistics New Zealand (SNZ). The sample household size (number of people) was consistent with the 2006 SNZ census statistics. Statistical differences between the survey data and census data were observed in the age distribution of the household occupants in the 0 – 14 years and 65+ age groups. The age groups 0 – 14 years, and the 65+ years were lower and higher respectively compared to the census statistics but the dominant age group, 15 – 64, was similar to that of the census.

[7] The mean of 'Activity2' was found to be statistically different at the 5% level across response categories. Early respondents reported higher potential use of the restored Pekapeka Swamp than late respondents.

[8] Due to time and budgetary constraints we were not able to make a follow-up on non-respondents which would have made the comparison possible.

Annual income distribution statistics from the survey reveal a lower proportion of households earning less than NZ$20 000 and more earning greater than NZ$50 000 compared to census statistics but the difference was not great. In the sample, the proportion of the respondents falling in the income brackets NZ$20 000 – NZ$29 999, and NZ$30 000 – NZ$49 999 is 15.4% and 19.2% respectively which compares favorably with New Zealand overall (15.4% and 21.1%).

Survey data on ethnicity shows higher proportions of European and lower proportion of 'Maori and Other' than the census data. The higher proportion of Europeans may be due to the different classifications used as the survey did not have a category for 'New Zealander' resulting in individuals in this category indicating their ethnicity as New Zealand European. The other explanation could be sampling error, or self-selection bias if most 'Maori' and 'Other' did not respond to the survey questionnaire. An analysis of gender statistics shows that the survey and census male and female proportions are nearly identical. On the basis of the above, it may be argued that the sample was reasonably representative of the population.

The majority of respondents (90%) indicated that they would support a restoration and preservation programme if it did not directly cost them any money and the most popular reason selected for supporting the "free programme" was that "Wetlands and nature are important". Among those who did not support the "free programme" (10%), old age and not believing that the programme would not directly cost them any money were the main reasons indicated for not supporting it. Potential use of the restored site was high with about 58% of the respondents indicating that they would spend at least 1 day per year at the restored site. A summary of the variable statistics is provided in Table 3.

4.2 Logit model estimations for DC responses

A logit model was fitted to the dataset using the forward stepwise selection procedure as programmed in the ‘SAS proc logistic command’. The output of the logit regression procedure is summarized in Table 4. The model’s Max-rescaled R-Square[9] of 0.3278 compares well with those of similar studies such as Walsh, Loomis and Gillman ((1984) and Brouwer and Bateman (2005) and is above the minimum standard of at least 0.15 for contingent valuation studies suggested by Mitchell and Carson (1989). The Hosmer and Lemeshow Goodness-of-Fit Test with a Chi-Square of 2.2024 (with 8 degrees of freedom) and p-value of 0.9742 is a strong indication that the fitted model is adequate. The predictive capacity of the fitted logit model is good at 79%.

The coefficient on Seed is significant at .0001 while the coefficients on Supports and Activity2 are significant at .01. Distance and Score[10] are significant at the .05 level. The results indicate that respondents expressing positive attitudes towards the environment (Score), environmental conservation (Supports), future potential use of the swamp (Activity2), and reside near the swamp were more likely to support the swamp restoration programme. The variables in the model have the expected signs indicating that respondents’ answers conformed to economic theory. This provides a positive test for internal or construct validity of the CVM as applied to the study site.

4.2.1 Estimating WTP from the Logit Model

The following section sets out the value functions arrived at for this analysis so that the study can be used by others for benefit transfer to value other wetlands in New Zealand (or

[9]Stepwise selection is known to produce invalid p-value statistics (Wilkinson and Dallal, 1981). To test the validity of the fitted models’ R^2 we tested our results using Wilkinson and Dallal’s tables and found the logit and OLS models’ R^2 to be significant at the 1% level suggesting that the stepwise selection procedure may have turned valid p-values.

[10] An analysis of the correlation between explanatory variables was carried out and Supports and Score were found to be significantly correlated. A logit model was fitted with Supports as an instrumental variable for Score but this did not provide a better model fit.

elsewhere if appropriate). Researchers looking for studies to include in benefit transfer and meta-analysis need this type of information to help them select relevant studies. One of the common criticisms of valuation studies is that they do not provide sufficient information on the econometric analysis (Brouwer, 2000).

From equation (3), the truncated mean WTP may be estimated from the fitted model using equations (7).

$$E(WTP) = \int_{0}^{MaxA} (1+\exp(-(0.728065-(0.0147A))))^{-1}\,\mathrm{d}A \qquad (7)$$

Equation (4) may be used to estimate the mean (or median) for the logit model. The estimated truncated mean and mean (or median) for the logit model are NZ$69.26 and NZ$49.53 per household per year for five years respectively[11]. The mean (or median) estimated from equation (4) is a more conservative estimate of WTP. The 'quasi-confidence' interval[12] (Seller, Stoll and Chavas, 1985) for mean (or median) WTP for the restoration and preservation of Pekapeka Swamp is NZ$34.02 to NZ$90.42 per household per year. The annual aggregate value was obtained by scaling up the mean (or median) WTP over the number of households in Hawke's Bay (54,618). Based on the mean (or median), annual aggregate household WTP was estimated to be NZ$2.71m with a 95% 'quasi-confidence' interval of NZ$1.86m to NZ$4.94m.

The parameters of the fitted logit model and their corresponding transformed coefficients (see Table 4) were used to construct the WTP value and probability functions given below.

$$WTP_i = -209.76 + 32.97^{*}Score_i + 108.01^{*}Supports_i - 1.04^{*}Distance_i + 6.09^{*}Activity2_i \quad (8a)$$

[11] US$1 = NZ$1.40 (http://search.worldbank.org/data?qterm=exchange%20rates&language=EN&format=html)

[12] Seller,Stoll,and Chavas (1985) construct 'quasi-confidence' intervals based on the lower and upper bounds for only one coefficient (coefficient on Bid) and ignore the rest. This method may be criticised for ignoring the variation in WTP due to the variation of other coefficients.

$$Pr(yes|Seed) = \{1 + \exp(-(0.728065 - (0.0147^{*}Seed_i)\}^{-1} \quad (8b)$$

A plot of predicted probabilities against the corresponding dollar Seed values generates a WTP probability curve as depicted in Figure 2. When the suggested bid amount is zero, we expect the probability of a “yes” response to be equal to or close to 1, assuming that the improvement is not a disutility to some respondents. From the WTP probability curve the predicted probability of a “yes” response corresponding to a zero bid amount is approximately 0.674 indicating that some respondents are indifferent to the wetland improvement programme even when the programme costs them nothing. Respondents who are indifferent when the bid amount is zero include those who do not enjoy direct and indirect use value of wetlands in general; those who reside too far from Pekapeka Swamp and are unlikely to benefit from it in future; those not concerned about the ecosystem services provided by wetlands; and those that regard agricultural conversion as a better land use.

The predicted probability of a “yes” response of 0.674 when the bid is set at zero can also suggest that the WTP distribution in the population from which our sample was drawn includes negative WTP values i.e. some respondents require compensation if the programme is implemented. However, it is not possible to estimate WTA from negative values of WTP because none of the respondents were asked a WTA question and any value generated would be misleading. However, extending the shape of the graph of the WTP probability function for the fitted logit model, to envelop negative WTP values, suggests that the truncated mean is likely to overstate the mean estimate by excluding the checked area above the curve as in Figure 3.

4.3 Estimating WTP from Open-ended (OE) responses

The estimation of mean and median WTP for the open-ended contingent valuation format is straight forward. The mean is calculated as the average of the stated maximum WTP amount by summing up household maximum WTP amounts and dividing the sum total by the number of households. Mean WTP for the sample was estimated to be NZ$47.88 per household per year for five years and lies within a 95% confidence interval of NZ$40.59 to NZ$55.16. The sample median WTP is NZ$30.00. The mean is higher than the median suggesting that the sample WTP distribution is skewed to the right. Using the median as an estimate of the welfare benefits of the programme may understate the true benefits as it ignores or places little weight on the high values expressed by some respondents.

The sample mean and median WTP estimates may be used to estimate aggregate value estimates for the Pekapeka Swamp by scaling them up over the total number of households in the Hawke's Bay. Based on 54,618 households (SNZ, 2006) the annual aggregate values, obtained by scaling up the mean and median, are NZ$2.615m (with a 95% confidence interval of NZ$ 2.217m to NZ$3.013m) and NZ$1.639m respectively

4.3.1 The fitted OLS Model for Open-ended (OE) responses

WTP for the restoration and preservation of Pekapeka Swamp can also be modeled as a function of a number of variables using OLS. The main objective was to identify important factors that influence respondents' open-ended WTP responses to the valuation question for the restoration and preservation of Pekapeka Swamp. An OLS forward stepwise selection procedure was employed to fit the best linear model for the dataset. The results of the OLS regression are summarized in Table 5. In the step wise regression Activity2 (future potential use of the swamp) was the most significant variable with the largest partial R-square. The variables retained in the model are all significant at the 0.05 level and have the expected signs suggesting that the open ended WTP responses conform to economic theory. For example, the coefficient on Distance has a negative signs indicating that willingness to pay declines with distance from the study site (Sutherland and Walsh, 1985; Pate and Loomis, 1997; Bateman et al., 2006).

Score, Distance, and Activity2 are significant in both the OLS model and the logit model indicating robustness across models. It is interesting to note that both models estimate spatially sensitive valuation functions (se equations 8a and 9). However, differences between the models are observed in terms of other explanatory variables. For example, MIncome and Membership are significant in the OLS model but not in the logit model while Supports is significant in the logit model.

The estimated WTP function from the fitted OE WTP model is:

$$\begin{aligned} WTPOE_i = {} & -4.56619 + 0.00034^{*}MIncome_i + 9.24995^{*}Score_i - 0.25606^{*}Distance_i \\ & + 23.03401^{*}Membership_i + 1.95781^{*}Activity2_i \end{aligned} \tag{9}$$

4.4 Present value (PV) and net present value (NPV)

To estimate the present value and net present value for Pekapeka Swamp over a 5 year period, annual aggregate benefits and costs of the programme were discounted to a common point in time (2008). We assumed that the costs presented in the Pekapeka Swamp Management Plan 1998 – 2003 and Pekapeka Wetland Management Plan 2005 – 2010 were the only costs incurred under the programme, and that the purchase price of the land acquired by HBRC reflects the true opportunity cost of that land i.e. forgone agricultural production. The total budget estimates for the two plan periods were NZ$844,278 and NZ$630,900 ± NZ$25,000 respectively.

New Zealand public sector discount rates for cost benefit analysis are as follows; 8% is set as the default discount rate for projects that are difficult to categorize; 6.4% is a risk free rate set at the current interest rate on New Zealand 10-year bond; and 3.4% is the real risk free rate (6.4% less inflation rate of 3%). For this analysis we used discount rates of 3.4%, 6.4%, 8%, and 10% to investigate the sensitivity of the results to the discount rate used. The 10% rate was included to provide a conservative estimate.

Results of the analysis, presented in Tables 6 and 7, indicate positive Present Value (PV) and Net Present Value (NPV) of benefits from the preservation and restoration programme ranging from NZ$6.83 million to NZ$17.71 million, and NZ$5.05 million to NZ$16.39 million respectively.

The median of the WTPOE model provides the lowest PV and NPV of NZ$6.83 million and NZ$5.05 million respectively, at a discount rate of 10%. The HBRC's policy programme for the restoration and preservation of Pekapeka Swamp even based on a very conservative discount rate meets economic efficiency criteria. If the mean of the WTPOE model is used instead of the median, the lower bound estimate at the 3.4% level become NZ$12.24 million and NZ$10.93 million for the PV and NPV respectively. The present value (NZ$17.71 million) and net present value (NZ$16.39 million) obtained using the truncated mean of the logit model provide the highest values or upper bound at the discount rate of 3.4%.

5. Conclusion

In the past, failure to appreciate the value of Pekapeka Swamp resulted in decisions that permitted the degradation of the swamp resulting in the loss of potential economic benefit. The study demonstrates that the CVM may be used to provide important input into the policy decision-making process that delivers outcomes consistent with utility maximization. However, it must be borne in mind that wetlands are a complex commodity for which there are no market prices. A lack of scientific understanding and experience with placing a value on a wetland will mean not all the values associated with a wetland are included.

Valuations can provide more insight into the trade-offs between market activities and environmental quality. As the extent of the contribution ecosystems services make to well-being is better understood there is an increasing demand for methods that make the value of ecosystems more explicit and allow this value to be considered in the decision making process. This demand has been difficult to satisfy as original empirical studies, as has been done for the valuation of Pekapeka Swamp, are time-consuming and costly to produce.

This study estimated the total economic value of the restoration and preservation programme for Pekapeka Swamp and tested the economic efficiency of the programme by comparing the costs and benefits. Results from a final usable sample of 231 households, after removing inconsistent responses, indicate that households in the Hawke’s region would pay, on average (depending on the model used) between NZ$30.00 and NZ$ 72.38 per household, per year for five years. Unit value ranges between NZ$ 17,898 and NZ$43,179 per hectare per year, and net present value ranges between NZ$5.05 million and NZ$16.39 million depending on the model and discount rate used.

In our study, we also observe that household income (MIncome), distance to the site (Distance), membership of an environmental organization (Membership), expression of potential future use of the restored wetland (Activity2), demonstrating value for the environment (Score), and attitude towards environmental improvement (Supports) provide consistent drivers of WTP for the restoration and preservation of Pekapeka Swamp. The high significance of Activity2, a constructed index measuring the potential future use of the restored Pekapeka Swamp, demonstrates the importance of the use value component of WTP. The negative sign of the coefficient on Distance confirms the expectation that WTP declines as the distance from the site increases. The other variables listed above have a positive influence on WTP as expected.

Value estimates from this survey may be used in conjunction with other decision making criteria to enhance HBRC's policy decision-making process so that policy outcomes that are consistent with the regional community's preferences are achieved. The values estimated in this study may also be used to justify past and future expenditure under the Pekapeka Swamp management plans. For example, more funds may justifiably be allocated to replanting, landscape development and any other outstanding work that would quicken the delivery of outcomes as the aggregate annual value currently represents considerable lost access value for residents in the region. WTP estimates also suggest that an extra payment on the utility account could be a possible alternative source of funding for the programme.

This study has contributed to literature by providing for the first time the potential economic value of the restoration and preservation of Pekapeka Swamp. However, there are still several limitations that offer possibilities for future work. First, in our survey the non-response rate was high, and if non-respondents' preferences differ significantly from those of respondents, the value estimates may suffer from potential non-response bias. This suggests that future studies should include the data from all the heterogeneous groups constituting the population of Hawke's Bay. Second, this study uses the Contingent Valuation Method that estimates total economic value and not the individual values of ecosystem services provided by the wetland. Future research employing choice experiments may be conducted to estimate individual values for ecosystem services of the swamp.

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Figures and Tables

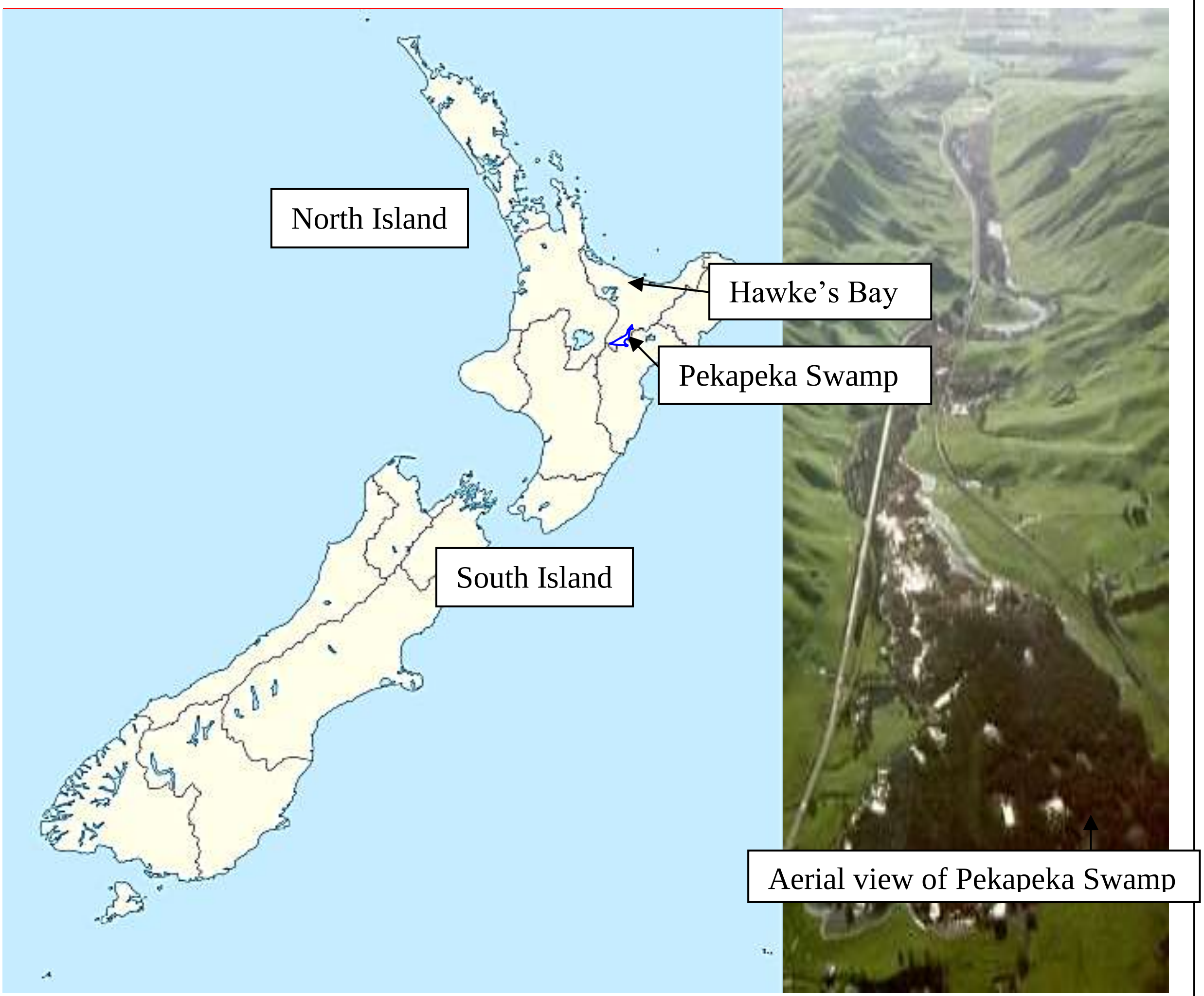

Figure 1 Map of New Zealand showing the location of Pekapeka Swamp in Hawke's Bay and an aerial view of the site

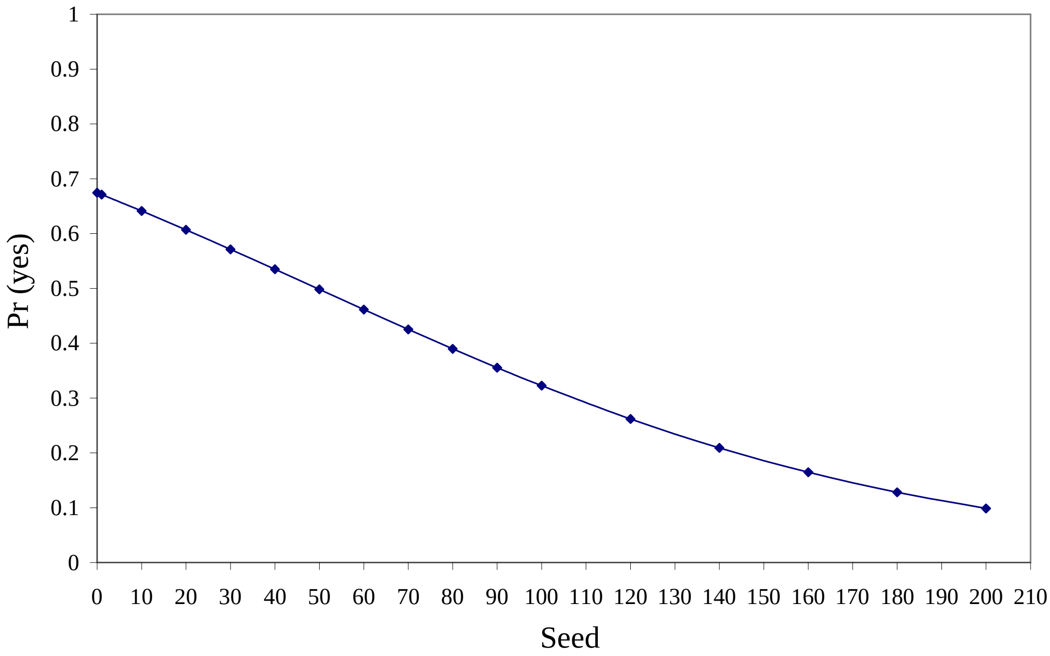

Figure 2 Graph of WTP function for the logit model

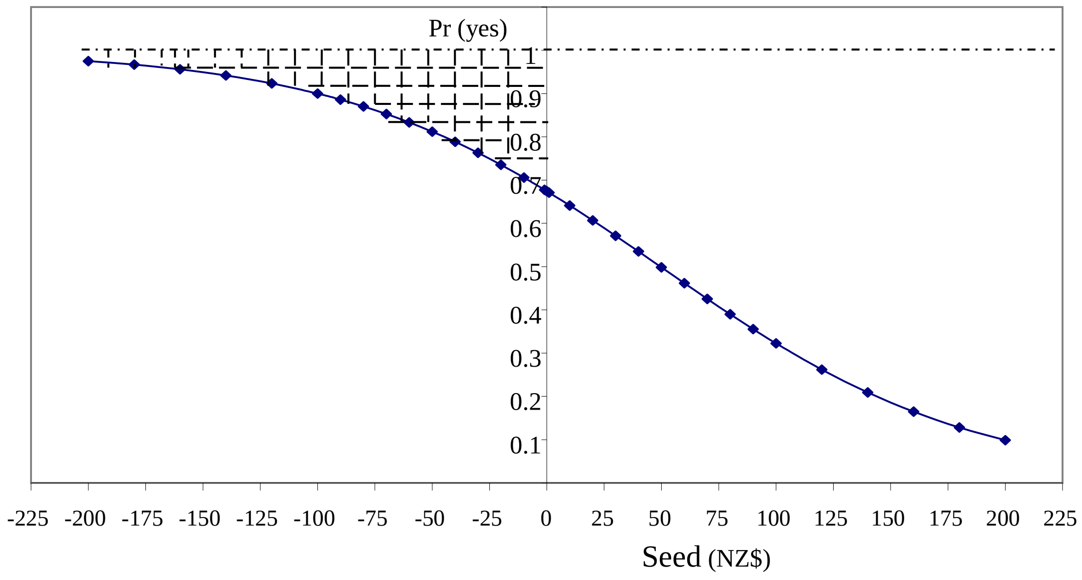

Figure 3 Graph of WTP function for the logit model

Table 1 Responses categories to the CV Question

Genuine zeroes	77 (19.01%)
Protests	48 (11.85%)
Refusals	41 (10.12%)
No opinion	17 (4.20%)
Incomplete valuations	21 (5.19%)
Non-zero responses	201 (49.63%)
Total responses	405

Table 2 Description of variables

Variable	**Description**
Active	Index for current wetland activities (continuous)
Activity2	Score for future potential use of the restored Pekapeka Swamp
Age	Age of household representative completing the form in years
Aware	Awareness of the existence of the Pekapeka Swamp (Yes = 1; No =0)
Distance	Distance of respondents' residence to the site in kilometers
Educ	Level of education of the household representative (high school + in years)
Employ	Employment status of household representative (employ = 1; 0 otherwise)
Gender	Gender of household representative (Male = 1; Female = 0)
Income	Annual household income (coded)
Membership	Membership of environmental group (yes = 1; no = 0)
MIncome	Annual household income in 2008 NZ$
Score	Household average score for attitude towards the environment
Seed	Bid offered in 2008 NZ$
Size	Number of persons in household
Supports	Indicates attitude towards environmental conservation (yes = 1; 0 otherwise)
WTPOE	Respondents' open-ended WTP response
YDC	Response to the DC question (yes = 1; no = 2)

Table 3 Summary of variables statistics

Variable	N[1]	Mean	Standard Dev.	Sum	Minimum	Maximum
Active	231	6.95	5.53	1606.00	0.00	24
Activity2	231	7.57	6.20	1748.00	0.00	28
Age	231	58.82	14.62	13587.00	21.00	92
Aware	231	0.80	0.39	185.00	0.00	1
Distance	231	34.46	28.74	7960.00	4.70	198
Educ	231	5.25	2.64	1213.00	0.00	16
Employ	231	0.58	0.48	133.00	0.00	1
Gender	231	0.51	0.50	117.00	0.00	1
Income	231	5.87	3.21	1356.00	1.00	12
Membership	231	0.16	0.36	36.50	0.00	1
MIncome	231	53701	32128	12404885	5000	115000
Score	231	2.64	0.87	610.75	0.00	4
Seed	231	77.48	51.23	17898.00	1.00	200
Size	231	2.49	1.38	576.00	1.00	8
Supports	231	0.90	0.31	206.00	0.00	1
WTPOE	231	47.88	56.50	11060.00	0.00	300

[1]Excludes protests and inconsistent responses to the valuation question.

Table 4 Results of the logit model

Variable	**Coefficient**	**Transformed coefficient**	**Transformed coefficient*Mean**
Intercept	-3.0834[b] (1.1716)[1]	-209.7551	-209.7551
Score	0.4847[c] (0.2069)	32.9728	87.0482
Supports	2.6462[b] (1.0661)	180.0136	162.0122
Seed	-0.0147[a] (0.0034)		
Distance	-0.0153[c] (0.0069)	-1.0408	-35.8660
Activity2	0.0895[b] (0.0282)	6.0884	46.0892
E(WTP) ($)			49.53
Number of observations	231		
AIC	265.014		
Schwarz Criterion (SC)	285.669		
-2 Log L	253.014		
		Pr>Chi-Square	
LR Chi-Square df =5	64.9257	<.0001	
Score Chi-Square df = 5	51.3125	<.0001	
Wald Chi-Square df = 5	38.0346	<.0001	
Residual Chi-Square df = 9	11.1531	0.2654	
H&L[2] Goodness-of-fit test			
Chi-Square df = 8	2.2024	0.9742	
R-Sq 0.2450	Max-rescaled R-Sq 0.3278		

[a]Significant at 0.001; [b]significant at 0.01; [c]significant at 0.05; [1]Standard errors are listed in parentheses; [2]Hosmer and Lemeshow

.

Table 5 Maximum likelihood estimates and model fit statistics for OE WTP model

Variable	**Parameter Estimate**	**Standard Error**	**Type II SS**	**F Value**	**Pr > F**
Intercept	-4.56619	11.97122	364.4	0.15	0.7032
MIncome	0.00034[a]	0.00011	24039	9.60	0.0022
Score	9.24995[b]	4.28984	11646	4.65	0.0321
Distance	-0.25606[b]	0.11669	12062	4.82	0.0292
Membership	23.03401[b]	9.41725	14986	5.98	0.0152
Activity2	1.95781[a]	0.58104	28440	11.35	0.0009
Number of observations	231				
R-Square	0.2323				

[a]Significant at 1%; [b]significant at 5%

Table 6 Aggregate benefit estimates for Pekapeka Swamp over 5 years in NZ$$_{2008}$ (million)

	TEV per year	TEV over 5 years	PV (r = 3.4%)	PV (r = 6.4%)	PV (r = 8%)	PV (r =10%)
Logit Model						
Truncated Mean WTP	3.78 (42,322)*	18.91	17.71	16.77	16.31	15.77
Median WTP	2.71 (29,547)*	13.53	12.67	11.99	11.66	11.28
WTPOE Model						
Mean WTPOE	2.62 (28,565)*	13.08	12.24	11.59	11.28	10.90
Median WTPOE	1.64 (17,898)*	8.19	7.67	7.26	7.07	6.83

*The values in parenthesis are the respective unit values (per hectare per year) based on 91.55 hectares

Table 7 Net Present Value of Pekapeka Swamp over 5 years in NZ$$_{2008}$ (million)

Model	**r = 3.4%**	**r = 6.4%**	**r = 8%**	**r = 10%**
Logit Model				
Truncated Mean WTP (NZ$m)	16.39	15.27	14.69	13.99
Median WTP (NZ$m)	11.35	10.49	10.05	9.50
WTPOE Model				
Mean WTPOE (NZ$m)	10.93	10.09	9.66	9.12
Median WTPOE (NZ$m)	6.36	5.76	5.45	5.05